

REMARKS

The Present Invention

The present invention relates to a polybenzazole article that comprises a polybenzazole and a light-resisting agent.

The Pending Claims

Claims 1-3 and 6 are currently pending. Reconsideration of the pending claims is respectfully requested.

Amendments to the Claims

The claims have been amended so as to more particularly point out and distinctly claim the invention. In particular, claim 1 has been amended to recite that the light-resisting agent is at least one member selected from the group consisting of *m*-phenylenediamine, *p*-phenylenediamine, *o*-aminophenol, 2-amino-4-nitrophenol, 2-aminophenol-4-sulfonamide, and 1,8-diaminonaphthalene. This amendment is supported by the specification at, for example, page 6, lines 18-21 and lines 37-38 and Examples 1-9. No new matter has been added by way of this amendment.

Summary of the Office Action

Claims 1-3 and 6 stand rejected under 35 U.S.C. § 103(a) as obvious in view of So et al. (U.S. Patent 5,552,221).

Examiner Interview

Applicants wish to thank Examiner Truong for the courtesies extended to one of applicants' representatives, Kristen J. Harrell, in the telephone conversation that took place June 15, 2004. During the course of that telephone conversation, applicants confirm that Examiner Truong agreed to enter the amendment for claim 1, previously recited in the "Response to Office Action" dated April 21, 2004 (which was not entered per the Advisory Action dated May 13, 2004). The same amendment to claim 1 is presented herewith.

Examiner Truong stated that the application, with claims as submitted herein, will be allowed. Other than this response, it is believed that no further action on the part of applicants is required.

Discussion of the Obviousness Rejection

According to the Examiner, So et al. discloses a polybenzazole article comprising polybenzazole and a naphthol dye. The Examiner concedes that So et al. does not disclose the specific light-resisting agents recited in the pending claims. However, the Examiner alleges that one of ordinary skill in the art would have been motivated to use the claimed light-resisting agents with a reasonable expectation of success since So et al. used naphthol that absorbs light with a wavelength of 300-600 nm.

The Examiner also contends that the Rule 132 declaration submitted with the response to Office Action filed November 7, 2003, was not persuasive because claim 1 recites light-resisting agents beyond those evaluated in the declaration. In addition, the Examiner alleges that applicants previously argued that, by mixing two kinds of light-resisting agents, the strength retention will be higher. According to the Examiner, this statement implies that if only one claimed light-resisting agent is used, the strength retention will be lower than when two or more light-resisting agents are combined and, thus, likely to have a similar strength retention as a polybenzazole article containing naphthol.

The polybenzazole article comprising a specific light-resisting agent of the present invention is markedly superior in light resistance as compared to the polybenzazole article containing a dye (including naphthol) as described in So et al. To further highlight the surprising and unexpected properties of the claimed polybenzazole articles, applicants submitted two Rule 132 Declarations. In the first Rule 132 declaration, submitted with the response to Office Action on March 24, 2003 (hereinafter "Declaration 1"), polybenzazole articles that contained a light-resisting agent recited in the amended pending claims (e.g., Samples 6-14 of Table 1 of Declaration 1) had a strength retention of 51-85% based on the conditions used for testing. Comparatively, a polybenzazole article that is *not* treated with a light-resisting agent (Sample 1 of Declaration 1) had a strength retention of only 35% based on the conditions used for testing. Also, polybenzazole articles containing light-resisting agents disclosed by So et al., such as Rhodamine B, Acid Fuchin, sodium salt, Acid Black 48, and Acid Blue 40 (e.g., Samples 2-5 of Table 1 of Declaration 1), had a strength retention of only 35-45% based on the conditions used for testing.

In the second Rule 132 declaration, submitted with the response to Office Action on November 7, 2003 (hereinafter "Declaration 2"), polybenzazole articles (Samples 6 and 7 of Table 1 of Declaration 2) containing two light-resisting agents recited in the pending claims

showed a strength retention of 34% or 55% based on the conditions used for testing. Comparatively, a polybenzazole article that is *not* treated with a light-resisting agent (Sample 1 of Table 1 of Declaration 2) had a strength retention of only 24% based on the conditions used for testing. Polybenzazole articles containing Rhodamine B, Acid Fuchin, sodium salt, 1-naphthol, or 2-naphthol as a light-resisting agent (Samples 2-5 of Table 1 of Declaration 2) had a strength retention of only 23-28% based on the conditions used for testing.

As is readily apparent from the results reported in both Declarations 1 and 2, comparison of the strength retentions between a polybenzazole article treated with a light-resisting agent disclosed by So et al. and a polybenzazole article *not* treated with a light-resisting agent at all indicates that the addition of the dyes disclosed by So et al. as light-resisting agents to polybenzazole articles did *not* result in significantly higher strength retention (compare Samples 2-5 v. Sample 1 of Declaration 1 and Samples 2-5 v. Sample 1 of Declaration 2). The polybenzazole articles that contained light-resisting agents disclosed by So et al. had strength retentions that were essentially the same as the untreated sample. Therefore, the dyes described in So et al. are not particularly useful as light-resisting agents of polybenzazole articles. Consequently, contrary to the Examiner's assertion, these data demonstrate that not every dye that absorbs light with a wavelength of 300-600 nm is suitable for the present invention.

Regarding the Examiner's contention that if only one claimed light-resisting agent is used, the strength retention will be lower than when two or more light-resisting agents are combined, the data in Declaration 1 demonstrate that using one claimed light-resisting agent still provides a polybenzazole article with greater strength retention than a polybenzazole article containing a light-resisting agent disclosed by So et al. For example, Samples 6-11 (Table 1 of Declaration 1) contained only one light-resisting agent recited in the amended claims, and the corresponding polybenzazole articles still had much higher strength retention compared to an untreated polybenzazole article or a polybenzazole article containing a dye disclosed by So et al. (Samples 1-5 of Table 1 of Declaration 1).

The amended claims recite *both* functional (allows for a regular reflectance of the article of not more than 30% in not less than 30% of the wavelength region of from 450 nm to 700 nm) *and* structural information (e.g., *m*-phenylenediamine, *p*-phenylenediamine, etc.) for the light-resisting agent. As described above, the fact that a dye absorbs light with a wavelength of 300-600 nm does not mean that the dye inherently has the same functionality

of the specific dyes recited in the pending claims. The addition of the light-resisting agents recited in the pending claims (i.e., *m*-phenylenediamine, *p*-phenylenediamine, *o*-aminophenol, 2-amino-4-nitrophenol, 2-aminophenol-4-sulfonamide, and 1,8-diaminonaphthalene) significantly improves the strength retention and light-resistance of polybenzazole articles compared to other conventional dyes that absorb light with a wavelength of 300-600 nm.

Regarding structure, So et al. does not teach nor suggest the structures of the claimed light-resisting agents. In particular, So et al. discloses the use of naphthol, which has a structure that is completely different than any of the light-resisting agents recited in the pending claims.


According to the Examiner, after having read the disclosure of So et al., one of ordinary skill in the art would have been motivated to select naphthol, a dye that absorbs light with a wavelength of 300-600 nm, knowingly alter its structure, and selectively arrive at the light-resisting agents recited in the amended pending claims (i.e., *m*-phenylenediamine, *p*-phenylenediamine, *o*-aminophenol, 2-amino-4-nitrophenol, 2-aminophenol-4-sulfonamide, and 1,8-diaminonaphthalene). However, based on the foregoing discussion, this view is not correct. The data in the present specification and Declarations 1 and 2 demonstrate that a dye that absorbs light with a wavelength of 300-600 nm does not mean that the dye inherently has the same functionality of the specific dyes recited in the pending claims. Moreover, as the Examiner has conceded, So et al. does not teach structural equivalents of the claimed light-resisting agents. Thus, So et al. simply does not provide any teaching or suggestion that explicitly or implicitly would lead one of ordinary skill in the art to arrive at the present invention as defined by the pending claims. In the absence of such a teaching or suggestion, it cannot be properly said that the present invention is obvious in view of So et al. Applicants respectfully request that the obviousness rejection be withdrawn.

Conclusion

The application is considered in good and proper form for allowance, and the Examiner is respectfully requested to pass this application to issue. If, in the opinion of the Examiner, a telephone conference would expedite the prosecution of the subject application, the Examiner is invited to call the undersigned attorney.

In re Appln. of Kodama et al.
Application No. 09/502,834

Respectfully submitted,



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Date: June 21, 2004



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:

Tetsuo KODAMA et al.:

Serial No. 09/502,834:

Group Art Unit: 1711

Filed on February 11, 2000:

Examiner: Duc Truong

For: POLYBENZAZOLE ARTICLE AND PRODUCTION METHOD THEREOF

DECLARATION UNDER 37 CFR 1.132

Honorable Commissioner of
Patents and Trademarks,
Washington, D.C. 20231

Sir:

I, Tetsuo KODAMA, whose full post office address is
c/o Toyo Boseki Kabushiki Kaisha, Research Center, 1-1,
Katata 2-chome, Ohtsu-shi, Shiga 520-0292 Japan, sincerely
declare:

That my education and employment history is as follows:

That I was graduated from Department of Marine Science,
Faculty of Marine Science and Technology, Tokai University
in March 1981,

That I completed the master course study of
Environmental Science at Hiroshima University, graduate
school (Faculty of Integrated Arts and Science) in March
1983,

In April 1983, I was employed by Toyo Boseki Kabushiki
Kaisha, and I have been engaged in the research and
development of base films of magnetic tapes, PPS, RO module,
PBO and so on at Toyo Boseki Analytical Research Center;

That I am one of the inventors of the above-identified
U.S. Patent Application No. 09/502,834 and familiar with the
subject matter of this invention;

That I have reviewed the Office Action dated May 7,
2003 issued in the above-identified application and have
directly conducted the following experiments to show that
the polybenzazole article of the present invention
comprising a light-resisting agent defined in claim 1 is
markedly superior in light resistance as compared to a
polybenzazole article comprising, as a light-resisting
agent, naphthol described in So et al. (USP No. 5,552,221);

That the following Experiments demonstrate such fact,
the results of which follow hereunder;

Experiments

(1) Object

To prepare the polybenzazole (PBO) article of the present invention comprising a light-resisting agent defined in claim 1 and a polybenzazole article comprising, as a light-resisting agent, naphthol described in So et al. (USP No. 5,552,221) and evaluate the light resistance thereof.

(2) Preparation method of samples for evaluation

(Preparation of PBO sample)

A spinning dope containing polyparaphenylene benzobisoxazole (14.0% by weight) obtained by the method described in USP 4,533,693 and having an intrinsic viscosity as measured with a methanesulfonic acid solution at 30°C, of 24.4 dL/g, and polyphosphoric acid containing phosphorus pentaoxide in 83.17% by weight was spun. The dope was passed through a metal net filter, and kneaded and defoamed in a twin screw kneader. The pressure was elevated, the dope temperature was maintained at 170°C, and the dope was spun at 170°C from a spinneret. The delivered yarns were cooled with cooling air at 60°C and wound around a godet roller to afford a spinning speed. The yarns were led into an extraction (coagulation) bath of a 20% by weight aqueous phosphoric acid solution maintained at a temperature of $20 \pm 2^\circ\text{C}$. The yarns were successively washed with ion exchange water in a second extraction bath, and immersed in a 0.1 mol/L sodium hydroxide solution for neutralization. The resulting undried PBO yarns were preserved in water and used as a sample.

(Preparation of treating solution for light-resisting agent)

Each light-resisting agent shown in the following Table 1 was dissolved in ethanol such that the concentration was 1 g/100 ml and the liquid temperature was about 40°C to give a treating solution. However, since Acid Fuchin, sodium salt has low solubility, the concentration was less than 1 g/100 ml.

(Treatment with light-resisting agent)

The undried PBO yarn (249d, 166f) obtained above was placed in each treating solution while preventing entanglement, and stood at about 40°C for 4 hr. Redundant treating solution was removed by pressing waste (JK wiper paper) and the yarn was dried to give a sample for evaluation.

(3) Evaluation of light resistance

The samples for evaluation (PBO fiber) obtained above were folded three times (for forming a kink band and accelerating the light resistance evaluation) and subjected to xenon light exposure at 83°C for 24 hr. The tensile strength of mainly the part folded 3 times was measured and strength retention was calculated with the tensile strength (DT 40.8 (g/d)) of dry PBO yarn samples free of treatment with a light-resisting agent as 100%.

(4) Evaluation results

The obtained strength retention is shown in the following Table 1.

Table 1

Sample	Light-resisting agent	Strength retention (%) after xenon light exposure for 24 hr
1	Blank (not treated)	24
2	Rhodamine B	26
3	Acid Fuchin, sodium salt	28
4	1-Naphthol	23
5	2-Naphthol	27
6	o-Aminophenol/p-Phenylenediamine=1/1	34
7	m-Phenylenediamine/p-Phenylenediamine=1/1	55

The light-resisting agent (Samples 6 and 7) of the present invention is oxidized in an aqueous solution to form a condensate (colors the aqueous solution black), reacts with or adsorbs to PBO yarn to dye the PBO yarn. By mixing two kinds of light-resisting agents, the

oxidation/condensation proceeds further to afford a striking light resistance effect (higher strength retention (%)).

(5) Conclusion

The polybenzazole articles (Samples 6 and 7) of the present invention comprising a light-resisting agent defined in claim 1 showed significantly higher strength retention (%) (dramatically superior in light resistance) after xenon light exposure for 24 hr, as compared to polybenzazole articles (Samples 2 - 5) comprising, as a light-resisting agent, a dye, particularly naphthol (Samples 4 and 5) described in So et al. (USP No. 5,552,221).

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Signed at Shiga, Japan on this 29th day of October, 2003

Tetsuo Kodama

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Tetsuo KODAMA